DOCUMENT RESUME

ED 482 286 TM 035 372

AUTHOR Aagaard, Lola; Boram, Robert

TITLE Cognitive Development of Fourth Graders in a High-Stakes State.

PUB DATE 2003-11-00

NOTE 16p.; Paper presented at the Annual Meeting of the Mid-South Educational Research Association (Biloxi, MS, November 5-7, 2003).

PUB TYPE Reports - Research (143) -- Speeches/Meeting Papers (150)

EDRS PRICE EDRS Price MF01/PC01 Plus Postage.

DESCRIPTORS *Cognitive Development; *Elementary School Students; *Formal Operations; *Grade 4; High Stakes Tests; Intermediate Grades; *Piagetian Theory; State Programs; *Test Results; Testing Programs

IDENTIFIERS *Concrete Operations; Kentucky

ABSTRACT

Jean Piaget's classic theory of cognitive development would imply that the higher-order items on the Kentucky state assessment would only be possible for students well into concrete operations or beginning formal operations. The implication would be that Kentucky fourth graders who are not fully concrete yet may be hitting a developmental ceiling on the state assessment. In the week following state testing in spring 2003, 87% (n=47) of the total fourth grade at one Kentucky elementary school was tested with the Piaget conservations tasks for number, liquid, mass, and area, and tasks involving group classification and class inclusion. Fewer than half the students passed all the conservation and classification tasks, and nearly 20% missed two to six tasks each. About 28% of the total were also in transition to formal thought. This fourth grade clearly had a wide range of cognitive developmental levels that may have an impact on the school's standing on the state assessment. (Contains 4 tables and 12 references.) (SLD)

Cognitive Development of Fourth Graders in a High-Stakes State

Lola Aagaard and Robert Boram

Morehead State University

Paper presented at the annual meeting of the

Mid-South Educational Research Association

Biloxi, MS, November 6, 2003

Introduction

High-Stakes Testing

Recent estimates indicate that nearly half of the states in the U.S. have some form of high-stakes educational assessment with incentives for schools to improve their annual test performance (Amrein & Berliner, 2002). Kentucky is one of those states. After the entire public school system was declared unconstitutional in 1989 (Rose v. Council for Better Education, 1989), the legislature drafted the massive Kentucky Educational Reform Act (KERA) (Kentucky General Assembly, 1990). Specified in KERA were six learning goals that emphasized thinking, problem-solving, subject matter integration, and real-life application of knowledge (Kannapel, Aagaard, Coe, & Reeves, 2000). The law also mandated the development of an assessment and accountability system to ensure students met the learning goals. That system has since undergone several changes but remains in place with some sort of testing for students in grades 3-12 (Petrosko, 2000), and rewards or assistance for schools, depending on whether they improve their scores or not.

The Kentucky state assessment initially was more performance-based than it is now (Kannapel, et al., 2000), but after several studies of the reliability and validity of various sections (Petrosko, 2000), it moved toward a more traditional format with multiple-choice as well as open-response items. Writing portfolios continue to be included in the accountability design, but performance events and math portfolios were dropped in the mid-1990s (Kannapel, et al., 2000; Petrosko, 2000).

Analysis of Released Items from Kentucky's Test

An inspection of items from a previous year's tests (1999 is the only year that has been released) indicates that there is a higher-order component to the testing even at the fourth grade level. For example, in the reading section, students are asked to respond to several questions after reading a short excerpt of writing. Generally two or three of the questions are factual, with answers contained in the reading selection, while one calls for a conclusion or deduction on the part of the student based on several pieces of information in the reading. A typical open-response item in reading asked the student to identify three qualities shared by the children profiled in the reading excerpt and explain how those qualities would make them successful. Logical thought would be required to produce a high-scoring answer because the question requires analysis and thinking about cause and effect.

Items in the science section require even more logical analysis than those in the reading section. Some multiple-choice items involved the interpretation of charts or drawings. For instance, one listed the temperature readings of a liquid that were recorded every minute for five minutes. The question was what would the temperature of the liquid be in minute 6? Students would need logical skills to interpret the data given and be able to answer the questions – this is essentially a number series item, requiring analysis of the pattern. An open-response science item required ability in scientific reasoning, as it asked students to determine what procedural errors were made in a simple described science experiment and how they might correct those errors.

The writing tasks also require logical skills and the ability to categorize. One task listed six different endangered animals, where they lived, and how many were left in the

wild. The child's task was to write an article to tell the class which animal he/she would like to save and why. The scoring rubric specifies that logical order and coherence is important, as well as detailed support of the main ideas.

Piaget's View

Jean Piaget's classic theory of cognitive development would imply that the higher-order items on the Kentucky state assessment would only be possible for students well into concrete operations or beginning formal operations (Bjorklund, 1989). Piaget believed that the transition from preoperational thought (during which children have the capability of symbolic thought but not logical thought) to concrete (or logical) thought took place around the age of seven (Bjorklund, 1989). He would have expected most fourth grade students, who are typically age 9-10, to be well into the concrete stage and capable of thinking logically as long as they had physical objects in front of them or at least in mind. He would not, however, have expected most of them to be capable abstract or systematic thinkers, as that was characteristic of his formal stage, which did not begin until age 11 or 12 (Bjorklund, 1989).

The implication of this is that Kentucky fourth-grade children who are NOT fully concrete yet may be hitting a developmental ceiling on the state assessment. A study by Bakken, Thompson, Clark, Johnson, and Dwyer (2001), indicated that 50 percent of the fifth grade students they tested were still preoperational. Bitner (1989) noted that most of the sixth through tenth grade students she tested over a period of 18 months were not operating at a formal stage level. The authors of the state assessment apparently assumed that students were developmentally ready for the types of questions it contained, but this may not be the case. Thus, the developmental level of the students being tested should be

of great interest to educators, especially because the high-stakes associated with the Kentucky assessment affect teachers rather than students.

Method

During the week following state testing in the spring of 2003, eighty-seven percent (N=47) of the total fourth grade at one Kentucky elementary school was individually tested at the school with the Piaget conservation tasks for number, liquid, mass, and area, as well as tasks involving group classification and class inclusion. A combinatorial logic task tested for formal thought ability. The tasks took 15-20 minutes to administer per child and included all the procedures outlined below. All students were given stickers and a pencil upon conclusion of testing.

1. Conservation of number – the researcher lined up 10 red checkers and asked the child to do the same with black checkers. Child was asked if each row had the same number or if one had more, and why. Researcher spread out one row of chekcers and asked the questions again.

2. Conservation of liquid -- researcher poured equal amounts of water into two identical glasses and asked the child which one had more or were they both the same, and why. Researcher then poured water from one glass into a third container that was taller and thinner and asked the questions again.

3. Conservation of mass -- researcher had two same-size balls of clay and asked child if they were the same size or was one bigger, and why. Researcher smashed one ball of clay flat and asked the questions again.

4. Conservation of area -- researcher had two equal-sized sheets of green paper and placed a plastic cow on each. Child was asked if each cow had the same amount of grass to eat or whether one had more, and why. Researcher added barns to each sheet of paper, clustering them in one corner on one sheet and spreading them around randomly

on the other. Child was asked the same questions after each group of barns was added, up toeight barns per sheet (some of which were two-story, while others were single-story).

5. Classification -- researcher offered the child 18 paper cutouts that were of three different shapes and colors and two different sizes. Child was asked to put the things that went together into stacks or groups. After one sort was done, child was asked to do it a different way, if possible.

6. Class inclusion -- Child was shown 12 plastic checkers, 10 red and 2 black. After agreeing that all were plastic checkers, child was asked if there were more red or more black checkers. Then child was asked if there were more red or more *plastic* checkers.

7. Letter combinations -- Given the letters A, B, C, and D, the child was asked to list all possible combinations of those letters -- taken singly, two at a time, three at a time, or four at a time.

Results and Discussion

Fewer than half of the students tested passed all the conservation and classification tasks (see Table 1). A little more than a third missed one task (predominantly area), but nearly 20 percent missed two to six tasks each. A breakdown of the specific tasks missed is contained in Tables 2, 3, and 4. About 28 percent of the total 47 were also in transition to formal thought, beginning to give systematic combinations of at least two letters at a time in the combinatorial logic task.

This fourth grade clearly has a wide range of cognitive developmental levels that may have an impact on the school's standing on the state assessment. If Piaget's theory

is correct, at least the 20 percent of the class that missed two or more tasks might not be expected to do as well on the test as those who were farther into the concrete stage. In contrast, the 28 percent entering formal thought would be expected to score the highest on the higher order questions on the assessment. If an inspection of the test scores that are to be returned this fall bears this out, then there are related implications for instruction.

Bakken, et al. (2001) followed in the footsteps of research from over two decades ago (Henry, 1978; Silverman, 1978; Lawson & Wollman, 1975) in attempting instructional intervention to increase children's stage of cognitive development. Developmentally appropriate hands-on instruction with materials designed to promote operational thinking significantly increased concrete thinking in 5th graders over a control group in just eight weeks (Bakken, et al., 2001). Another vintage study (McCabe, 1978) looked at a variety of measures of the openness of classrooms and found nongradedness to correlate significantly and positively with the conservation skills of children in the primary grades.

These elements (hands-on developmentally appropriate instruction in a nongraded setting) should sound familiar to educators in Kentucky because these were originally part of the primary program mandated by KERA in 1990 (Kannapel, et al., 2000). The primary program initially included seven critical attributes, among them developmentally appropriate practices and multi-age/multi-ability grouping (Gnadinger, McIntyre, Chitwood-Smith, & Kyle, 2000). But to many Kentucky primary teachers, the program became synonymous with just multi-age/multi-ability grouping and when a law interpreted that attribute more flexibly in 1997, many felt that the primary program really

no longer existed (Gnadinger, et al., 2000). As accountability pressure from the state assessment filtered down into the primary grades from the accountable 4th and 5th grade level, many of the developmentally appropriate activities also largely disappeared from primary classrooms (Kannapel, et al., 2000). Thus primary classrooms looked more and more like "regular school" – children of the same age doing traditional seatwork. It would be ironic if the traditionally-minded attempts to get young children ready for the high-stakes test in 4th grade are the very things that are keeping some of them from doing well on it.

References

Amrein, A.L. & Berliner, D.C. (2002, March 28). High-stakes testing, uncertainty, and student learning *Education Policy Analysis Archives*, *10*(18). Retrieved November 2, 2003 from http://epaa.asu.edu/epaa/v10n18/

Bakken, L., Thompson, J., Clark, F. L., Johnson, N., Dwyer, K. (2001). Making conservationists and classifiers of preoperational fifth-grade children. *Journal of Educational Research*, *95* (1), 56-61.

Bjorklund, D. F. (1989). *Children's thinking: Developmental function and individual differences.* Pacific Grove, CA: Brooks/Cole.

Henry, J. A. (1978). The transition from pre-operational to concrete-operational thinking: The effect of discrimination and classification activities. *Journal of Research in Science Teaching, 15*(2), 145-52.

Gnadinger, C., McIntyre, E., Chitwood-Smith, T. & Kyle, D. (2000). Primary program. In J.M. Petrosko & J.C. Lindle (Eds), *2000 Review of research on the Kentucky Education Reform Act.* Retrieved November 2, 2003 from http://www.kier.org/primary.html

Kannapel, P.J., Aagaard, L., Coe, P., & Reeves, C.A. (2000). *Elementary change: Moving toward systemic school reform in rural Kentucky.* Charleston, WV: AEL.

Kentucky General Assembly. (1990). *The Kentucky Education Reform Act of 1990, H.B. 940*, Vol. I. Frankfort: Legislative Research Commission.

Lawson, A., & Wollman, W. T. (1975). *Encouraging the transition from concrete to formal cognitive functioning – an experiment.* (ERIC Document Reproduction Service No. ED207821)

McCabe, J. S. (1978, March). *Characteristics of classroom environments and their relationship to cognitive development.* Speech presented at the annual meeting of the American Educational Research Association, Toronto, Ontario, Canada.

Petrosko, J. M. (2000). Assessment and accountability. In J.M. Petrosko & J.C. Lindle (Eds), *2000 Review of research on the Kentucky Education Reform Act.* Retrieved November 2, 2003 from http://www.kier.org/assessment.html

Rose v. Council for Better Education, 60 Ky. 1289, 790 S.W.2d 186 (1989).

Silverman, P. S. (1978, March). *The influence of social experience in the classroom on cognitive development.* Paper presented at the annual meeting of the American Educational Research Association, Toronto, Ontario, Canada.

Table 1

Student Performance on Conservation and Classification Tasks (N=47)

Number of Tasks Missed	Number of Students	Percent
Zero	21	45
One	17	36
Two	5	11
Three	2	4
Four	1	2
Five	0	0
Six	1	2

Table 2

Number of Students Missing Only One Conservation or Classification Task (n=17)

Task	Number	%
Number	0	0
Liquid	3	6
Mass	1	2
Area	11	23
Classif. of Groups	1	2
Class Inclusion	1	2

Table 3

Number of Students Missing Two Conservation or Classification Tasks (n=5)

Tasks Missed	Number of Students	%
Liquid and Area	3	6
Liquid and Inclusion	1	2
Number and Area	1	2

Table 4

Number of Students Missing Three or Four Conservation or Classification Tasks (n=3)

Tasks Missed	Number of Students
Liquid, Mass, and Area	1
Number, Liquid, and Area	1
Liquid, Mass, Area, and Inclusion	1

U.S. Department of Education
Office of Educational Research and Improvement (OERI)
National Library of Education (NLE)
Educational Resources Information Center (ERIC)

ERIC Educational Resources Information Center

REPRODUCTION RELEASE

(Specific Document)

TM035372

I. DOCUMENT IDENTIFICATION:

Title: Cognitive development of fourth graders in a high-stakes state	
Author(s): LOLA AAGAARD, ROBERT BORAM	
Corporate Source: Morehead State University	Publication Date: 11/6/03

II. REPRODUCTION RELEASE:

In order to disseminate as widely as possible timely and significant materials of interest to the educational community, documents announced in the monthly abstract journal of the ERIC system, *Resources in Education* (RIE), are usually made available to users in microfiche, reproduced paper copy, and electronic media, and sold through the ERIC Document Reproduction Service (EDRS). Credit is given to the source of each document, and, if reproduction release is granted, one of the following notices is affixed to the document.

If permission is granted to reproduce and disseminate the identified document, please CHECK ONE of the following three options and sign at the bottom of the page.

The sample sticker shown below will be affixed to all Level 1 documents

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY

Sample

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

1

Level 1

☒

Check here for Level 1 release, permitting reproduction and dissemination in microfiche or other ERIC archival media (e.g., electronic) *and* paper copy.

The sample sticker shown below will be affixed to all Level 2A documents

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE, AND IN ELECTRONIC MEDIA FOR ERIC COLLECTION SUBSCRIBERS ONLY, HAS BEEN GRANTED BY

Sample

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

2A

Level 2A

☐

Check here for Level 2A release, permitting reproduction and dissemination in microfiche and in electronic media for ERIC archival collection subscribers only

The sample sticker shown below will be affixed to all Level 2B documents

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

Sample

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

2B

Level 2B

☐

Check here for Level 2B release, permitting reproduction and dissemination in microfiche only

Documents will be processed as indicated provided reproduction quality permits.
If permission to reproduce is granted, but no box is checked, documents will be processed at Level 1.

I hereby grant to the Educational Resources Information Center (ERIC) nonexclusive permission to reproduce and disseminate this document as indicated above. Reproduction from the ERIC microfiche or electronic media by persons other than ERIC employees and its system contractors requires permission from the copyright holder. Exception is made for non-profit reproduction by libraries and other service agencies to satisfy information needs of educators in response to discrete inquiries.

Sign here, please

Signature: Lola Aagaard	Printed Name/Position/Title: LOLA AAGAARD; Assist. Professor	
Organization/Address: 503 Ginger Hall, Morehead State Univ. Morehead, KY 40351	Telephone: 606 783 2531	FAX:
	E-Mail Address: l.aagaard@moreheadstate.edu	Date: 11/5/03

(Over)

III. DOCUMENT AVAILABILITY INFORMATION (FROM NON-ERIC SOURCE):

If permission to reproduce is not granted to ERIC, or, if you wish ERIC to cite the availability of the document from another source, please provide the following information regarding the availability of the document. (ERIC will not announce a document unless it is publicly available, and a dependable source can be specified. Contributors should also be aware that ERIC selection criteria are significantly more stringent for documents that cannot be made available through EDRS.)

Publisher/Distributor:
Address:
Price:

IV. REFERRAL OF ERIC TO COPYRIGHT/REPRODUCTION RIGHTS HOLDER:

If the right to grant this reproduction release is held by someone other than the addressee, please provide the appropriate name and address:

Name:
Address:

V. WHERE TO SEND THIS FORM:

Send this form to the following ERIC Clearinghouse:

However, if solicited by the ERIC Facility, or if making an unsolicited contribution to ERIC, return this form (and the document being contributed) to:

ERIC Processing and Reference Facility
4483-A Forbes Boulevard
Lanham, Maryland 20706

Telephone: 301-552-4200
Toll Free: 800-799-3742
FAX: 301-552-4700
e-mail: info@ericfac.piccard.csc.com
WWW: http://ericfacility.org